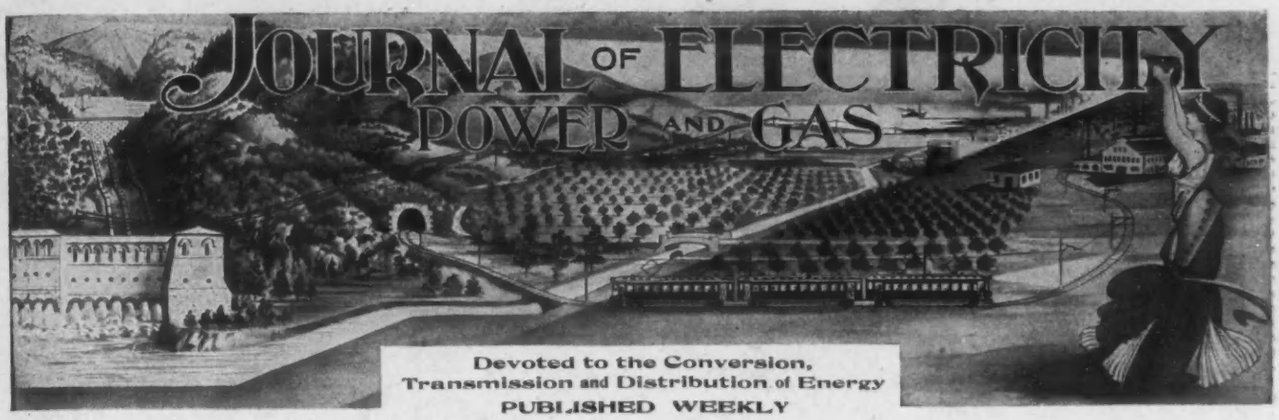

BY THE TECHNICAL PUBLISHING COMPANY, 111 NEW MONTGOMERY STREET, SAN FRANCISCO CAL.
Entered as second-class matter May 7, 1906, at the Post Office at San Francisco Cal., under the Act of Congress March 3, 1879.

VOL. XX. No. 14 SAN FRANCISCO, CAL., April 4, 1908. Yearly subscription $2.50. Single copies 10 cents Back numbers prior to current month 25 cents.

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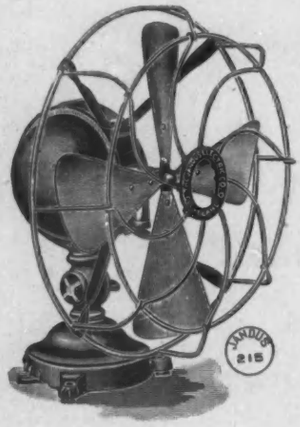

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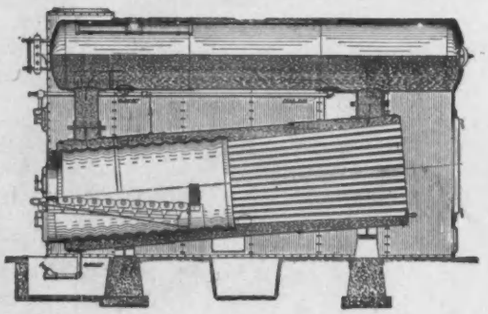

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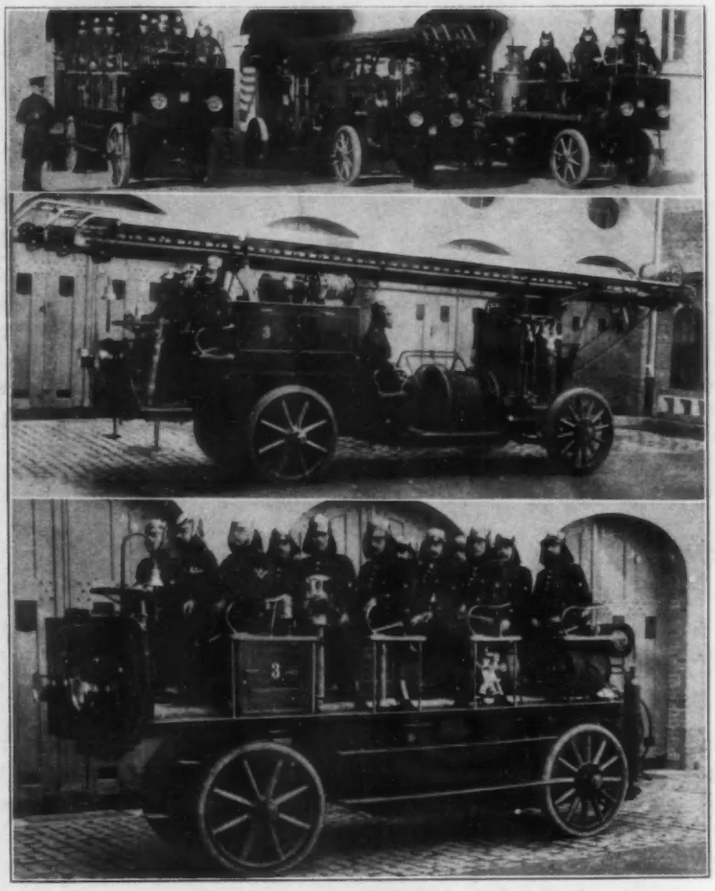
VOLUME XX. SAN FRANCISCO, CAL., APRIL 4, 1908 No. 14

BERLIN-CHARLOTTENBURG FIRE DEPARTMENT.

Charlottenburg is the largest suburb of Berlin, and noted for its splendid streets, squares and municipal institutions. There are three fire stations, one of which was equipped with automobiles two years ago. Ten weeks ago the third depot was furnished exclusively with power-driven vehicles, and there are now in Greater Berlin two stations where horses are entirely eliminated. The wagons illustrated herewith are all electrically-driven, and consist of a gas engine, ladder and steam engine. The former (Fig 1) offers accommodation for twelve men, and carries all saving appliances as it proceeds the fire train. Of special interest is the frame, which does not contain channel iron, as usual, but cast-iron tubes which serve also as water carriers, for no less than 450 liters of water is carried within the two longitudinal and transverse pipes. This water is let out by the pressure of carbonic anyhydride. This is used for the first attack, when the big fire engine has not yet arrived. The car is propelled by electric motors of 15-25 horse-power. They are mounted within the front wheels, assuring a direct drive. Current is taken from a battery below the chassis containing 80 cells. The power is sufficient for 30 kilometers, and run at a speed of 20 to 30 kilometers per hour. The batteries are arranged for 29-ampere charging current and 130 amperes for discharge. The switchboard allows five different positions, or five speeds ahead; also one for stopping and one reverse. All wheels are fitted with solid rubber with anti-skidding tires. The wheels are of cast steel.



ELECTRIC FIRE FIGHTING APPARATUS.

As regards the manner of propelling the ladder and steam fire engine, it is similar to the gas engine, only the water pipes are replaced by channel beams acting as chassis-girders. On the ladder vehicle the battery is mounted upon the car in two boxes, used as seats. Here also a third electromotor is to be fed, which has to lift and slide out the heavy ladder, and rests within the turn-table. The ladder consists of steel pipes that telescope.

The steam engine is an electromobile. Thus steam is saved for the pumps, and the readiness to act immediately is greatly favored. The batteries are mounted underneath the first bench, one-third and two-thirds beneath the second cross-seat.

In the barn there is a post beside each vehicle, with cable-joint for charging. Energy is taken from the 3,000-volt rotary current produced by the municipal plan. A special transformer sub-station is built which steps down the current to 120-volt. In the motors continuous current of 55 amperes and 220 volts is used.

MEASURING GAS LIGHT AND HEAT.*

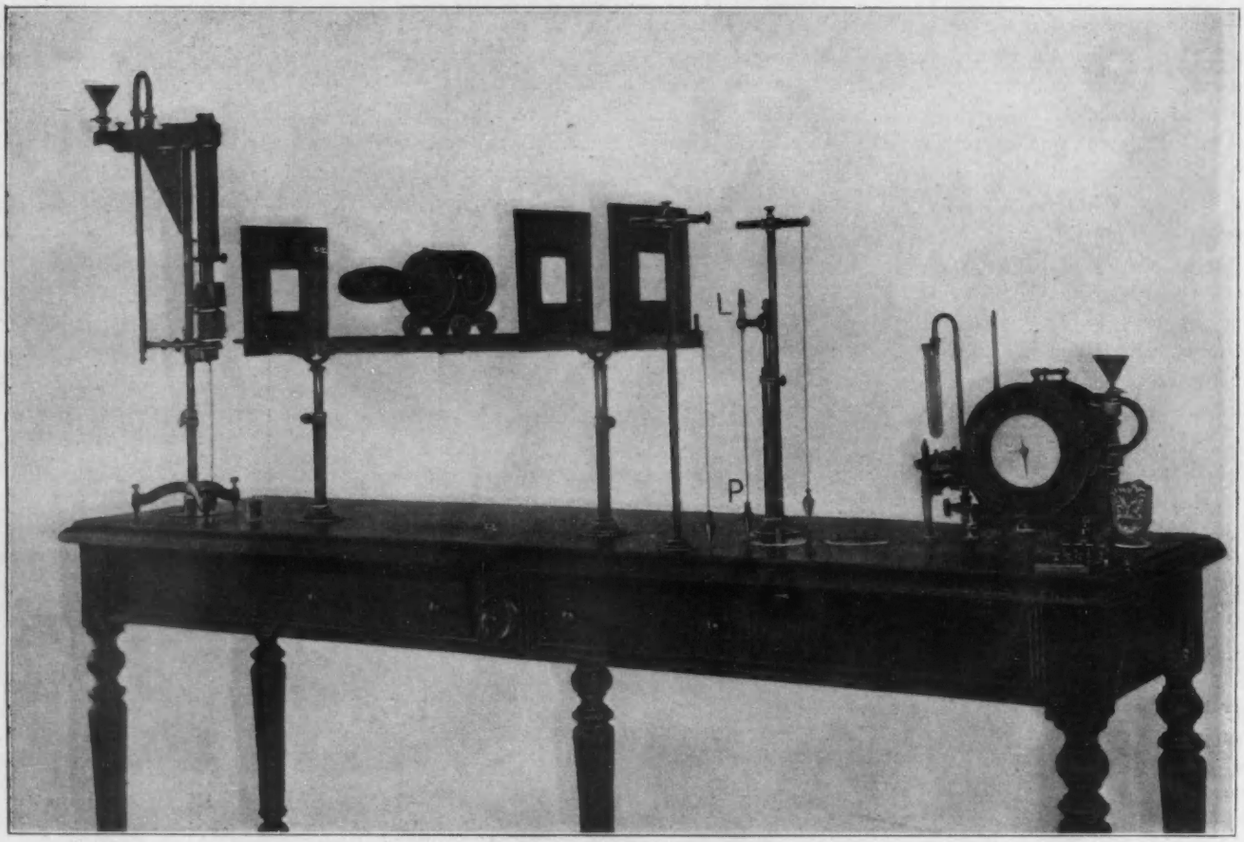
By J. B. Klumpp, Gas Expert of the National Civic Federation.

Photometry is that branch of scientific measurement which deals with the comparison of the illuminating values of different sources of light, and in the sense in which it is generally used by the gas industry, it treats of the illuminating value of a gas flame.

The illuminating value of a gas flame depends greatly upon the method in which the gas is burned, and therefore, to make relative comparisons it is absolutely necessary that the gas should be burned under certain specifications. These specifications are generally uniform throughout England and the United States, although some slight modifications have occurred from time to time. For instance, the illuminating value of the gas is always expressed in figures that give the candle power of the gas flame when burning at the rate of five cubic feet per hour; and the measurement of the gas so burning should be at a certain prescribed atmospheric pressure and temperature, and if not burning under these specific conditions, its volume should be corrected so as to give a volume equivalent to that under the prescribed pressure and temperature.

In the United States this standard of atmospheric pressure is 30 inches barometer and standard of temperature 60 degrees Fahrenheit. If these standard conditions did not prevail, it would be impossible to compare the candle power as the tendency of the gas to expand on decreasing barometer and increasing temperatures is very great, and in all perfect gases, follows a definite law that enables this correction to be easily made.

In addition to these conditions, it has been found necessary to describe the type of burner through which the gas shall burn, as the gas flame should be stable, uniform in shape and comparatively quiet. If the five feet of gas should be forced through a very small burner and appear to blow, so to speak, the true illuminating value is not obtained, and the gas will give considerably less than its normal light. On this account it is customary to measure the gas as burned through standard burners or tips.



GENERAL VIEW OF PHOTOMETER READY FOR USE.

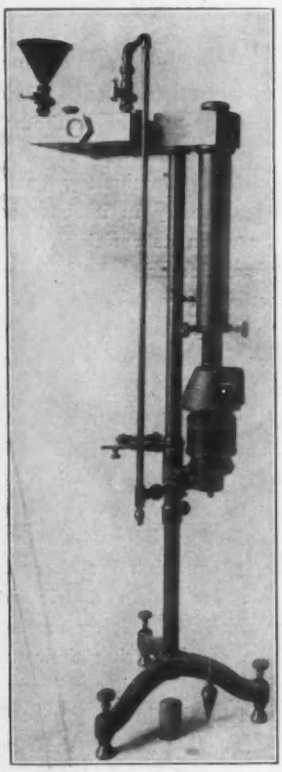
In the case of coal gas, an argand burner of the Sugg D type (named after the Englishman who invented it) has been generally adopted. This burner has been perfected recently so that it will burn various kinds of coal gas and regulate the mixture of gas and air more definitely. This improved type of standard burner is illustrated in the Metropolitan No. 2, invented by Mr. Carpenter, of London, and is being used throughout England and some cities in the United States.

The higher value illuminating gases, such as carburetted water gas and the richer oil gases, have been found to give more satisfactory results in burning through what is called the "open flame E. H. (excavated head) lava tip" of the No. 6 or No. 8 size. This tip is the small lava slotted tip that is used in commercial practice.

*Reproduced by courtesy of "Public Service."

Optical Comparison Necessary.

Now, to determine the value of a gas flame, the measurement of the light can only be obtained through some optical comparison, and to do this it is necessary that a standard or a light having a known illuminating value be used. The practice for many years has been to assume the candle as this known illuminating value, and, in England, the British standard candle was the first unit adopted, and even to-day is considered the unit of measurement, although the candle itself is not always the operating standard. An ordinary candle would not do for such scientific work, so the original English specifications designated the illuminating value of one candle to be the light given out by a sperm candle, weighing six to a pound, and burning 120 grains per hour. These specifications, however, have since been modified, and the number of strands of the wick and the quality of the sperm and the exact dimensions of the candle itself have been further specified.



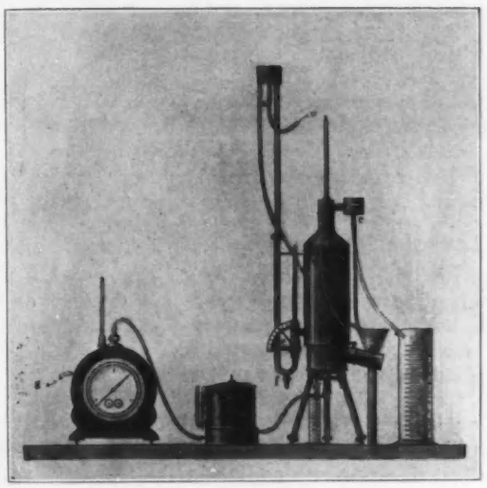
THE PENTANE LAMP.

In burning these candles, they must be delicately mounted in a balance, so that the rate of consumption shall be known within prescribed limits. As the progress of the art developed, it was found that for rapid and accurate work it would be more convenient to adopt some standard that could be more easily operated and give generally more uniform results, and to this end Mr. A. Vernon Harcourt, an eminent English authority, invented his 10-candle power pentane lamp; and the original lamp, once having its value determined by candles, is easily duplicated.

Since 1895 this 10-candle power pentane lamp has been generally used throughout England and many cities in the United States as a standard by which illuminating value of gas is determined. This lamp, as shown by the cut, is a very scientific instrument, and constructed carefully to prescribed specifications; it burns pentane, a refined distillate of petroleum, that is chemically prepared and constant, hence the light-giving value of the lamp is absolutely reproducible. Several secondary standards, such as the Edgerton and the Methven standards have been substituted by various companies for convenient use, but their value must first be determined either by comparing them with standard candles or by comparing them with a standardized pentane lamp. The Hefner lamp—a small 1-candle power or 2-candle power open flame lamp burning amyl-acetate—has been used as a standard by some countries and by the electrical industry in this country; but its unit is somewhat smaller than the British candle.

Principles of the Photometer.

Having a standard and the gas flame itself, it is necessary to have an instrument whereby these two sources of light may be accurately compared. Such an instrument is called a photometer. In this country the type of photometer generally used in gas works practice is the "bar" photometer, so named because a graduated bar is supported between the two sources of light and a carriage containing an illuminated disc is moved back and forth between these sources of light until it appears equally illuminated on both sides. This form of photometer is shown in the accompanying cut. It shows the method of comparing the gas flame with the 10-candle power pentane lamp standard. The standard lamp is shown on the left of the bar. The flame of this lamp and the flame of the gas are in direct horizontal line with the center of the disc of the carriage and the holes in the screens on the graduated bar. The gas flame should be shown burning from the tip at "L."



JUNKER GAS CALORIMETER.

The well-known optical principle of this comparison is that, first, the intensity of illumination of a lighted surface varies directly with the intensity of the light-source illuminating that surface. Second, the quality of light falling on this given surface varies inversely as the square of the distance of that from the light-source. As above stated, this might seem a rather complicated law, but it may be very simply expressed by saying if any one object is twice as far from a source of light as any other object, it will receive one-fourth of the amount of light per equal unit of surface. Applying this law to a disc supported on a graduated bar between a known source of light (as a standard) and the gas flame to be measured, it is very easy to determine the value of one light in terms of another.

The illuminated disc, known in this case as the Leeson disc, by which this point of comparison is measured, is of rather peculiar construction. It is formed generally of three pieces of white paper; the middle piece is of opaque, thick paper, uniform in quality, and finished on both sides, and it has a star stamped from its center. On each side of this is placed a thin sheet of white, rice tissue paper. These three pieces are cut round and placed between two discs of white French plate glass, so that their surfaces are flattened out.

The star opening cut in the thicker paper being more translucent than the surrounding field, when held up to the light, appears to be brighter. This disc, being placed on the bar, is moved first towards one and then towards the other light, until the disc, both sides of which are seen by the observer through reflecting mirrors, appears equally illuminated on the entire area of both sides, and the point at which this takes place on the bar determines the distance of equal illumination of both sources of light. The scale on the bar is so graduated or marked that the readings designate directly the exact ratio of value of the light sources.

Great Care Necessary.

In the cut of photometer herewith, on the right will be noticed a circular gas meter. This is a small wet meter with a revolving drum submerged about two-thirds of its distance in water. The gas entering this meter is measured by the compartments as they revolve above the water, and it is so designed that one revolution of the drum will pass one-twelfth of a cubic foot of gas. Therefore the meter drum, when passing gas at the rate of five cubic feet per hour will make exactly one revolution in one minute. This being carefully checked with a stop watch, the rate of consumption of the gas may be accurately determined and maintained.

A double dry governor is shown on the left of the meter. This regulates the pressure of gas to within a tenth of one inch of water pressure, as recorded on the "U" gauge above it. There is a micrometer cock between the governor and the gas flame that will enable the observer to regulate the size of the flame to a nicety and always allow of rapid adjustment to produce a uniform rate of flow of the gas being tested.

The positions of the standard light and the gas flame are determined by plumb-bobs that are suspended over centering lines engraved on the surface of the table. The graduated bar is supported between the two light sources; the middle of the scale has a plumb-bob that enables it to be also adjusted over a center line in the table. A very close adjustment of this scale may be made by means of a micrometer screw. Screens are placed on the photometer bar to prevent any extraneous light from entering upon the disc and also to protect the eyes of the observer. The disc in the box is made reversible so that each side may be exposed alternately to the different sources of light, which will eliminate any errors due to inequalities of the paper.

The photometer described as above should be erected in a room that is practically light-tight, with all outside light excluded, and the wall should be painted a dead black or a very dark green color. There should be no light objects in the room that may act as reflectors. The floor and the table should be comparatively firm and free from vibration. The room should be well ventilated and without drafts and the temperature as near 70 degrees as the climatic conditions will permit. It is convenient always to have window whereby outside light may be admitted when desired, but this should be protected by dark shutters during operation. After entering the darkened room, ample time should be given by the observers to accommodate themselves to the new light conditions before attempting to make any observations of candlepower.

The operation of reading photometrical apparatus does not necessitate any technical education or training. Observations of candlepower may be made by any intelligent person who will take pains and be careful in his work. However, it is absolutely necessary to have good instruments, carefully erected and calibrated—perfect standards and a systematic method of observing and checking all conditions and readings.

Values of Different Gases.

The candlepower of gases varies very greatly, according to the kind of gas and the method of its manufacture.

All gas is considered by the layman to be just gas, but the materials from which it is manufactured and the methods of manufacture vary so greatly that a gas should be generally described by its name, its candlepower, its analysis, or its heating value. Coal gas, for instance, is obtained from direct distillation of bituminous coal. The quality and kind of coal used determine generally the quality of the gas obtained; but this quality may be more or less improved or impaired according to the methods adopted in its manufacture. For instance, coal gas generally as understood in this country will vary from 12 to 16 candlepower, it will have a heating value from 550 to 620 British thermal units to the cubic foot, and will show analyses that are more or less similar in their general characteristics, but will vary according to the amount of illuminants and the methods of manufacture.

Carburetted water gas, the other illuminating gas in general use in this country, varies greatly in its character according to the quantity of oil used in its enrichment, and the method of treatment during manufacture. As it is generally known in every-day practice, it varies from 15 to 25 candlepower and from 550 to 650 British thermal units per cubic foot. Carburetted water gas can always be recognized by experienced gas men by its analyses, but these analyses vary, as stated before, with the quantity of oil used in its manufacture and also with the method of its treatment.

There are many other types of gases, such as natural gas, producer gas, and gases obtained as by-products from different manufactures; but these gases, with the exception of natural gas, are not suitable for urban distribution. They are complex in quality, generally containing more or less nitrogen, due to the injection of air during their process of generation, and are comparatively low in candlepower and heating value, but may be used locally in many cases as a fuel or for gas engine power purposes. But their use in general distribution has been found prohibitive.

Natural gas, of course, is obtained only in certain localities in the United States, and on account of its enormous volume of production and its practically uniform composition and high heating value it has been found suitable for general distribution. However, its candlepower is very low, generally about 4 candlepower, and in some few localities reaching, possibly, 10 candles. Its average calorific value is about 1,000 British thermal units per cubic foot. The reason for its comparatively low selling price is due, of course, to the fact that no works or materials are required for its production nor any manufacturing expense.

Gas Calorimetry.

Calorimetry, generally speaking, is a method of measuring heat, and, specifically speaking, it is a measurement of heat produced by the combustion of a certain substance or matter, such combustion taking place under prescribed conditions to warrant relative comparisons. As applied to gas in this country, it means the measurement of heat produced in burning one cubic foot of gas at a certain prescribed temperature and pressure. The temperature considered normal, or standard, in this country is 60 degrees Fahrenheit, while the normal barometric pressure is 30 inches of mercury. The volume of the gas burned in measuring its calorific value is corrected to these normal pressures and

temperatures in a way similar to that applied in the correction of the gas for photometrical purposes.

The instrument used to determine the heating value of any substance is called a calorimeter, and that used for any particular substance is generally designated by prefixing the name of the substance to be measured, hence the gas calorimeter or the coal calorimeter. The gas calorimeter depends for its action upon a most simple and controllable method—that of heating water. A certain quantity of water is heated and its rise in temperature is observed, and the quantity of gas burned being known, the heating value of the gas per cubic foot is easily determined. The heat unit as used in this country and England is the British thermal unit, generally expressed as a "B. T. U.," and is the amount of heat which is necessary to raise one pound of water one degree Fahrenheit at the temperature of 39 degrees Fahrenheit. It is nearly the same for each degree above that within the normal temperature of observation.

This heat unit is used to describe the amount of heat obtained in the combustion of various substances, including gas, and the amount of heat given off in the combustion of one cubic foot of gas is thus quoted as so many British thermal units, or B. T. U.'s. A gas of 575 B. T. U. has a heating value that will produce during its combustion enough heat to raise 575 pounds of water one degree Fahrenheit, or 57.5 pounds of water 10 degrees Fahrenheit.

The calorimeter, to give accurately relative comparisons, must be a practically perfect water heater; in other words, it must have an efficiency as near 100 per cent as it is possible to obtain. The water entering the calorimeter should be at the temperature of the room, or atmosphere, where the apparatus is erected. The gas being measured should and will be found to be practically at the same temperature as the atmosphere, owing to the fact that the meter and the contained water are practically at this temperature. The products of combustion leaving the calorimeter should be at this same temperature, or as close as it is possible to get them. Then, under these conditions, the quantity of water entering the instrument being accurately known and its increase in temperature or the difference between the outlet temperature of the water and the inlet temperature of the water being observed, these facts determine accurately the amount of heat absorbed by the water or the amount of heat given out by the combustion of the known quantity of gas.

The Apparatus Employed.

A cut of the calorimeter is herewith shown. The instrument in question is of the "Junker" type, more or less universally used throughout the world. It will be noticed that it has a wet meter similar to that in use with the photometer. From the meter the gas passes through a wet balanced governor regulating delicately the supply of gas to the burner.

The gas burner is placed under and inside of the water heater.

The inlet water passes over a small weir in an elevated cup provided with an overflow, thus maintaining a uniform head in the heater. The water is then led through the instrument through a series of pipes so arranged as to absorb all of the heat produced by the burning gas. The overflowing water is collected and measured.

The general practice abroad is to measure the water in a graduated vessel and this same practice is probably more universally applied in this country, but it will be found convenient to substitute a weighing scale, reading to hundredths of a pound and weigh the water, which result given in pounds, determines at once the heating value in thermal units which are expressed in terms of pound-degrees.

The heating value of a gas as generally expressed in this country is the gross of actual heating value, which is the heating value as determined by the calorimeter. The so-called "net" heating value is sometimes referred to, but being difficult to obtain accurately from all present designed calorimeters, it is not in general vogue. It means the heating value of the gas, when the water vapors of combustion go off as steam instead of being condensed to liquid form.

The heating value of a gas may be approximately determined if its analysis be correctly known. The analyses of all gases include only some 10 or 12 different kinds of gases which are the elementary gases of nature, and, with the exception of some more or less complex hydro-carbons, are themselves each definite in character.

ELECTRIC CABLES.*

By Henry W. Fisher.

During the winter of 1889, the writer first became connected with a cable manufacturing company. It is interesting to note the great improvements that have been made in this industry in the last twenty years.

For convenience, the different kinds of cables will be classified under three main groups, some of which will have subdivisions.

Telegraph Cables.

Less radical changes have been made in telegraph cables than in either of the other two groups. The old kind of insulation was cotton or jute impregnated with some approved compound, and there are persons to-day who still purchase cables of this make-up, in preference to paper insulated cables.

With increase in the length of telegraph circuits and changes in the instruments employed, it became necessary to reduce the electrostatic capacity, and so now dry paper insulation is used extensively, and combination cables consisting of two different sizes of conductors are frequently employed. Very often also, some of the insulated conductors are twisted in pairs so as to avoid inductive interferences from adjacent wires. The sizes of conductors employed vary from No. 18 to No. 13 B. & S. G., No. 14 being used most often. With cables of the most modern construction, good telegraphic service can be given over distances of 125 miles, and possibly farther. For the operation of quadruplex and Wheatstone instruments over such long distances, twisted pairs or their equivalent must be employed.

Telephone Cables.

The first telephone cables were insulated with cotton or jute, and afterwards paper was employed.

At first, the insulating material was thoroughly saturated with a good compound, paraffine being extensively used.

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*The Sibley Journal of Engineering.

The average electrostatic capacity required between each wire and the rest connected to the lead cover of the cable was .18 mf. per mile for No. 19 B. & S. G.

As the telephone circuits became longer, it was soon found that the electrostatic capacity must be reduced, and this eventually led to the celebrated Conference Specifications of the Bell Telephone Co. requiring the use of dry paper and an electrostatic capacity of .08 mf. per mile. In the early days, much experimenting was required in trying to apply the paper on the conductor so as to include a maximum amount of air. The earlier cables for the same capacity and number of twisted pairs were much larger than those of to-day. In addition to the methods of applying the paper, experiments had to be made to find the best paper to use, both as to size and specific inductive capacity Great care has to be exercised in removing all traces of moisture before applying the lead cover, and this is done by the use of hot ovens, vacuum tanks, etc.

With further increase in the length of telephone circuits, it was found necessary to use larger conductors so that No. 13 B. & S. G. is extensively employed.

For several years back, the Bell Telephone Co. has been requiring a test of "mutual" capacity, or the capacity between one conductor of a pair and its mate with all other conductors connected to the lead cover of the cable. This capacity is about two-thirds of the capacity by the old method, where one wire was tested against all the others connected to the lead cover.

After the introduction of the celebrated Pupin loading coils, for helping to neutralize the effects of capacity, it was found that slight telephonic disturbances, due to a condition of unbalance between adjacent pairs in a telephone cable, were greatly accentuated by the use of said coils. This led to the design of a special testing apparatus for measuring the unbalanced capacity, by the Bell Telephone Co., and to a new requirement stating that the average mutual capacity unbalanced between adjacent pairs should not exceed .000025 microfarads.

To meet this extremely difficult specification, considerable experimenting was required, and the method of doing it is kept as a trade secret with those few manufacturers who have successfully made cables meeting these requirements. Cables of this sort are generally used for toll and long-distance purposes, and the sizes of conductors employed are No. 16 and No. 13, with mutual capacities ranging between .065 and .08 mf. per mile.

The specified insulation resistance is generally 500 megohms per mile. There are many interesting things in connection with the manufacture, installation, testing, and use of telephone cables which cannot be considered in this short article.

Electric Light and Power Cables.

In the early manufacture of fibrous insulated cables, jute and cotton were extensively used for the body of the insulating material, and some approved compound for the filler. This was in the days when 1000 volts was considered a high voltage, and when the use of 2000 volts was extremely rare.

In times of emergency, some of these old cables have been worked successfully on arc circuits of from 4000 to 5000 volts.

This kind of insulation is not adaptable for very high voltages, because its efficiency depends largely upon the completeness with which the remaining space between the conductor and the lead cover is filled with insulating compound.

Therefore, for high voltage transmission, we have to use materials that have more body to them, such as paper, varnished cloth and rubber.

Paper Insulated Cables.

This kind of cable has given excellent satisfaction commercially up to 22,000 volts working pressure, and when the demand for cables to operate at higher voltages is created, paper insulated cables will no doubt be supplied, although the ultimate maximum limit of voltage cannot be said to have been as yet determined.

By the selection of the right materials properly applied and treated, paper insulation can be made of remarkable dielectric strength, and the theoretical or laboratory efficiency is many times the commercial efficiency attained in practice. Continual experiments, both commercial and laboratory, are necessary to show the manufacturer in what directions improvements can be made. With paper insulated cables, the use of a lead cover is absolutely essential for the purpose of preventing the absorption of moisture by the insulation. For the same reason, the ends of the cables must be provided with suitable terminals filled with insulating compound.

The Davis open-air terminal of the Standard Underground Cable Co. effectively excludes moisture from entering the cable, and at the same affords so good an insulation between the connector and the lead cover of the cable that the terminal can be used out of doors.

Paper insulated cables are made up in a great variety of forms, such as single conductor, duplex, triplex, multiple and concentric. The last, on account of the difficulty in making joints, is not used in this country as much as other styles.

In order to reduce the effects of induction and induced currents in the lead cover, it is best to use two conductor, three conductor and four conductor cables respectively, for single phase, three phase, and two phase circuits.

At the present time there are millions of feet of three conductor paper insulated cables working at 11,000 volts in such a successful manner as to completely satisfy the operators.

Paper insulated cables saturated with a soft, oily compound, do not have as high an insulation resistance in megohms as those where a harder saturating compound is used. The former, however, are preferable on account of greater dielectric strength, greater flexibility and less liability to cracks in the paper or compound.

Varnished Cloth Cables.

When varnished cloth was first used extensively in the insulating of parts of electric machinery, there was an objection to using it in cables because the insulation resistance was too low to meet the general cable requirements at that time. Since then, engineers have realized that high dielectric strength is more desirable than insulation resistance in megohms, and so the required megohms per mile are not nearly so great now as they were ten years ago. Moreover, the quality of varnished cloth has improved so that now higher insulation resistances are obtainable.

Varnished cloth cables have a high dielectric strength, and they seem to also withstand impulsive rises of voltage very much in excess of their normal working pressure.

The power factor of the ordinary varnished cloth is higher than that of saturated paper, and hence varnished cloth cables are apt to become somewhat warm when necessary to apply very high voltage under test or working conditions.

It is possible, however, to very much reduce this effect by the proper selection of the right materials, and by the method of manufacture.

Rubber Insulated Cables.

The use of rubber for insulating purposes is so old that it is hardly necessary here to speak of it from a historical standpoint. Cables of almost endless variety are insulated with rubber and covered with lead, which would no doubt be used more extensively for electric light and power cables were it not for the fact that it costs much more than paper, and decentralizes under heat. The best commercial grade of rubber compound used in cables has about forty per cent Para and thirty per cent Para, and is used so frequently that many different specifications have been drawn up by government engineers and others setting forth the various tests which the rubber compound must meet. The main object of these specifications is to make the requirements of such a nature that compliance therewith necessitates the use of full thirty per cent fine Para, and no rubber of inferior grade.

While for high voltage cables, it is best to use compound approximating thirty per cent fine Para rubber, yet it is doubtfully expedient to use so expensive a compound for cables operating at low or intermediate voltages up to 6600 volts. The judgment of an experienced manufacturer is often a safer guide as to right construction of cables than the arbitrary use of some particular specification that may not be suitable for the conditions.

Rubber insulated wires are used to a limited extent in telegraph and telephone cables. Where such cables are laid in water or in the ground, they are frequently protected with steel armor, either in the form of two steel tapes or else in a concentric layer of steel wires.

ELECTRICAL PURIFICATION OF WATER.

It is well known that many of the common and more dangerous impurities of water are organic or bacteriac. These may be removed by electrolysis, several methods of which have been well described by Henry Leffmann in the Journal of the Franklin Institute. In one of these, aluminum electrodes have been used, more or less loss of the metal occurring, it being converted into aluminum hydroxide. This combines with the organic matter and entangles the suspended substances, so that the water, after treatment, can be subjected to a rapid filtration, and will show material improvement in microbic content, especially if the amount of suspended matter and microbic content were previously high. On waters containing but little suspended impurity, living or dead, the purifying action is relatively low. The constant loss of the electrode is a most serious item of expense, generally overlooked in the experimental plants.

In the operation of the Anderson process of purifying water by agitation with metallic iron, attempts have been made to get more powerful action—that is, more rapid solution of the iron—by making it the positive pole of an electric system, but no practical advantage seems to have been attained. Recently, a process has been patented in which an electric current is passed from an inner to an outer pipe, the water flowing through the annulus.

Probably, the most practical benefit of the application of electricity to water purification will come from the indirect methods in which the electrical energy is used to produce an active disinfecting agent, and this then applied to the water. Of all the processes of this type, those which produce ozone seem to be most useful. This modification of oxygen can be obtained by several methods, but those in which electricity is employed seem to be alone applicable to the processes in question here. For the purpose high-tension currents are most economical, and the best yield is obtained by the so-called "silent discharge." It is now known that a spark or arc discharge will produce nitrogen oxides which are corrosive. It has also been determined that the air intended for production of ozone should be dry, otherwise hydrogen dioxide will be formed. The principal mechanical difficulty encountered in producing ozone on the larger scale by means of the electric discharge is to secure a suitable dielectric. Glass, porcelain, rubber, and other materials have been tried, but are so liable to fracture or perforation that serious interruptions of operation frequently occur. Continuity of action is very important in commercial processes, such as the purification of water, and when a large unit of the plant is out of use, in order to install a new dielectric, the condition is annoying.

The inventions of Vosmaer seem to overcome the difficulty, for he avoids the use of a special dielectric, employing only the dry air which is to be ozonized. The discharge takes place from thin metal strips, on which are saw-like teeth. These strips are held by porcelain sockets firmly in the center of metal pipes. Many of these pipes are combined in parallel, the strips being all connected with one pole, and the pipes with the other. An alternating current of high potential is allowed to flow through the arrangement, almost all the current passing by silent discharge, although at times a spark passes, but as there is no permanent dielectric, no damage is done. The sparking is too seldom to produce damage or any appreciable amount of objectionable gases. The drying of the air may be done by any of the known methods. Preference is given by Vosmaer to refrigeration, by means of an ordinary ice machine.

A plant capable of purifying many thousand gallons in twenty-four hours has been for some time in operation on the west bank of the Schuylkill River at the foot of Locust St., Philadelphia. The water is first roughly filtered. This operation is merely intended to remove the grosser suspended matter, as the ozone process proper does not accomplish this. As the main part of the operation is the destructive action of the ozone on the bacteria, it is not necessary for the preliminary filtration to be nearly so close as when the latter is the sole reliance (as in ordinary filter plants), hence the filter area in the ozone plant is relatively very much smaller, the rate of filtration being so much greater. The filtered, or, perhaps, we may call it, strained water, is passed into aerating towers. These are tall, narrow vessels, into which the water enters at the top and the ozonized air at the bottom, the latter under considerable pressure. In the experimental plant above mentioned, an exhibition mixing tower has been installed. This is a glass tube about sixteen feet high and ten inches in diameter. In this the admixture of the ozone current with the water current is well seen. Upon the thoroughness of this mixing depends, in large part, the thoroughness of the purification. The water escapes at the foot of the mixing tower, clear and practically sterile. It sometimes contains a small amount of ozone in solution, but this is not objectionable, and soon disappears, either by conversion into ordinary oxygen or by combination.

The advantages of the process may be summarized as follows: no objectionable chemical is introduced into the water; large filter beds are not required; the operation expenses are not high; the plant occupies a limited area, and the operation is simple and easily comprehended; the plant may be enlarged by the addition of new units without disturbing the original units; the sterilization is rapid and certain; the plant may be placed at any convenient point. The process seems to find even more valuable application to the purification of sewage than to ordinary water supply. Both of these problems are now among the most urgent questions of sanitation.

The extensive use of water in our domestic life, with the increasing sources of pollution, give importance to every method of purification, and processes that seem to be founded on scientific principles and seem capable of practical operation on a large scale, and to involve low operative cost, limited land area and freedom from dangerous chemicals, deserve careful investigation.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX APRIL 4, 1908 No. 14

EDITORIAL.

PHOTOMETRY.

Recent improvements in methods of producing light have emphasized the deficiency in satisfactory means of accurately measuring their absolute and relative intensity. For over two hundred years scientists have been working on this subject without finding a completely suitable solution. This work has been mainly for the purpose of establishing a reliable standard for comparison, as the slight mechanical difficulties of adjusting and moving the light to be tested have been easily overcome.

A standard of light, like any other standard, should be capable of being reproduced anywhere and everywhere by means of certain specifications. It does not seem practicable to maintain a standard for light comparison in some central archives as is done for length, weight or time, yet, to be of use, the investigations should all refer to one standard or to others easily convertible. There is no more striking example of the tenacious hold that an anachronism may get in technical or popular language than is shown in the steadfast adherence to the term candle-power as the unit of light long after tallow, wax, stearine, sperm and paraffine have been successively adopted and repudiated for ordinary lighting. The appropriateness of the second part of the expression is clear, when we consider that it is the measure of the rate of the expenditure of energy that becomes evident as light. But there still remains much to be desired in a more perfect standard of expression as well as of measurement.

The cause of this inexactness in nomenclature is based upon the lack of a universally acknowledged standard of intensity. Thus we find the English standard candle, the Carcel lamp, the Hefner and the Vernon-Harcourt pentane lamp, specified by various organizations and communities, with a preponderance of scientific use in favor of the Hefner. This is an open-flame lamp of precise dimensions, burning amyl acetate in a cotton wick adjusted to give a flame of definite height. Any variation due to the changes of barometric pressure, moisture and carbon dioxide present in the atmosphere are corrected from carefully prepared tables, but even these precautions do not compensate for the weakness of the flame, its red color and the intensity variation, with change in height. While probably the most reliable standard to date, it yet has much room for improvement. The relative value of these standards has been settled by the International Photometric Commission by stating that one Hefner is equivalent to 0.0930 Carcel and 0.0915 Vernon-Harcourt, it being generally assumed that the Hefner is equal to 0.88 English candle.

Because of the priority of gas lighting, the history of this development has been more closely identified with it than with electric lighting. It seems possible that the exact measurements and refined conditions under which an electric light can be produced may ultimately lead to its adoption for this purpose, especially with the metallic filaments now available. At present it is the most important secondary standard in general use.

Having adopted some standard of intensity, the next point is to standardize the direction of measurement, which may be either spherical, horizontal or lower hemispherical, according as the light is measured in all directions, in a direction of 45 degrees, or in the lower hemisphere of the plane of the source of light. The average or mean, obtained by rotating the light at a unit distance, gives the measure of illumination.

Slight changes in principle have been made in various photometric devices since the time of Bunsen, these improvements being mainly for convenience and portability. For rapidity and easy working a portable German instrument has been constructed which gives by direct reading the watts consumed, the horizontal candle and the watt per candle. Another new principle has been introduced in the flicker photometer in which two sources of light are alternately thrown on the same point in rapid succession. As a consequence, if unequal, the spot will flicker; when equal, it will remain constant.

This discussion has been limited to its scientific, rather than its practical application, the latter involving many other factors, such as wall-paper reflection or absorption and fixture design, which are not considered in the mere laboratory measurement. Unfortunately for accuracy, all these methods are limited in precision to the sensibility of the eye and are

consequently not so much physical as they are physiological, each depending largely upon the personal equation of the observer. There is probably no subject that offers a more attractive field of research than the problem of establishing a standard, for any predetermined color value, that can be defined in the terms of units of radiant power. These can be used as a primary standard with which the practical secondary and subsidiary standards could from time to time be compared.

PERSONAL.

R. Leo Van der Naillen, of Santa Rosa, has accepted the position of local manager of the Oroville Water, Light and Power Company.

George A. Scoville is in San Francisco to open a local branch house of the Dean Electric Company, of Elyria, Ohio. A full line of telephone apparatus will be carried.

Mr. C. C. Hillis's brother, Edward W. Hillis, has been for the past week a visitor among us. He left for the North, Wednesday, April 1st. Mr. Hillis's genial personality will always insure him a hearty welcome on his return.

Mr. Walter S. Heaton, of the Ohmer Fare Register Co., Dayton, Ohio, is in the city, having removed his headquarters from Los Angeles, where he has been for a number of years representing this company on the Pacific Coast. The Ohmer Fare Register Co., of Dayton, Ohio, is too well known to need any introduction from the "Journal."

Mr. C. E. Nestor, president of the Pacific Telephone Construction Co., was in Fresno the first of the week, and expects to arrange for the construction of some new country telephone lines in this vicinity in the near future. The Pacific Telephone Construction Co. is organized to develop the country lines, working in conjunction with the Pacific Telephone and Telegraph Co.

Mr. J. E. McGillivray, of the American Electric Telephone Co., has just returned from an extended trip through the country, and reports a great development in the growth of rural telephone lines. Mr. McGillivray's company is at present furnishing the equipment for new telephone plants at Cliffs, Wash., Chelan, Wash., and for a 100-line board and complete equipment at Hermiston, Oregon.

W. T. Goddard, electrical engineer of the Locke Insulator Manufacturing Co., is making an extensive trip through the West investigating high voltage insulator applications and transmission line and power house design. Mr. Goddard is making a special study of the influence of various climatic conditions upon the design of insulators for various localities, especially in view of designs for 100,000 volts and higher.

Mr. F. G. Waterhouse, general manager of the Southern Nevada Consolidated Telephones and Telegraph Co., has been spending some time at his home at Bolinas, near Sausalito. The Southern Nevada Co., of which Mr. Waterhouse is the directing head, operate exchanges at Manhattan, Tonopah, Goldfield, Rhyolite, Beatty, and Greenwater, and cover the entire Nevada gold country with a network of long distance lines.

REMOVAL NOTICE.

Mr. W. A. Eckberg, representing the following concerns, The Hart Mfg. Co., Frank Adam Electric Co., Condit Electrical Mfg. Co., The Peerless Electric Co., The Sachs Co., Enameled Metals Co., Hartford Time Switch Co., Willard Storage Battery Co., on the Pacific Coast, is now located in his new offices at 143 Second St., San Francisco.

OBITUARY.

Mr. Lester A. Pelton, the inventor of the Pelton waterwheel, died March 15th, at Oakland, California, aged 78 years. He came to California in the gold rush of 1849, and first used his wheel to develop power for gold mining in California. It is given to but comparatively few men to invent

a device that so materially affects the prosperity of a great industry as has the Pelton wheel influenced the utilization of water for power. Fewer still live to see the success of their proposal as tried by the test of time. Mr. Pelton was born at Vermillion, Ohio, in 1830, and has lived in California since 1849. His invention as developed by engineers has become almost synonymous for impulse wheels, and forms a lasting monument to his memory.

TRADE CATALOGUES.

The Steel City Electric Co., of Pittsburg, Pa., sends an illustrated folder describing Fullman water-tight floor outlets, National Code standard.

J. N. Kelman, 1000 North Main Street, Los Angeles, Cal., sends an interesting folder of the Kelman "Short-Circuit" Breakers, automatic, high voltage oil break.

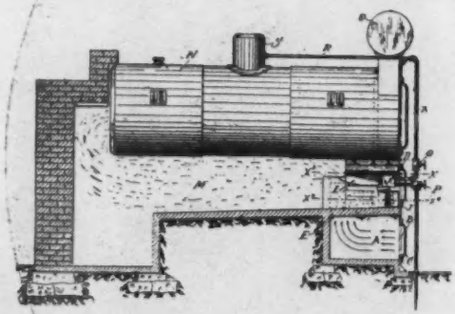
Bulletin No. 20, from the H. Krantz Manufacturing Co., 160-166 Seventh Street, Brooklyn, N. Y., illustrates and describes a beautiful line of standard and straight line panel boards and accessories.

Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., send a number of valuable booklets. No. 1104 deals with Westinghouse portable and precision meters, which are constructed not only for high initial accuracy, but also for permanency. This bulletin is replete with details of ammeter and voltmeter construction, and much matter of interest has been condensed in its 54 pages. No. 1135 illustrates and describes Westinghouse No. 114 and No. 134 railway motors for direct current service, containing many new and up-to-date features of motor construction. No. 1097 similarly displays types K and KG motors, direct-current, series wound, for use on cranes, hoisting machinery, etc. The Westinghouse No. 92A railway motor, direct-current, with a nominal rating of 35 horsepower, appears in Bulletin No. 1100. No. 1149 is devoted to type C transformers, single and three-phase, for mounting in man-holes. Folder 4049 shows Westinghouse type F circuit breakers.

PATENTS

MEANS FOR BURNING OIL. 882,205. Thomas C. Mason, Los Angeles, Cal.

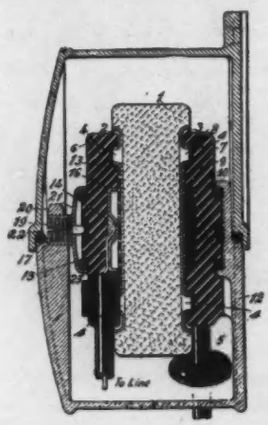
The apparatus for effecting the complete combustion of oil, consisting of a bottom chamber, doors at the front of said chamber, openings one at each side and at the inner end of the bottom chamber leading into lateral flues, one such flue on each side of the apparatus, a transverse flue



uniting the lateral flues, the single central discharge flue having curved walls projecting inwardly to the lower part of the combustion chamber, the flue having curved walls, being of gradually decreasing cross-sectional area, a burner in the combustion chamber, pipes connecting the burner within the combustion chamber.

LIGHTNING-ARRESTER. 882,265. Newitt J. Neall, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.

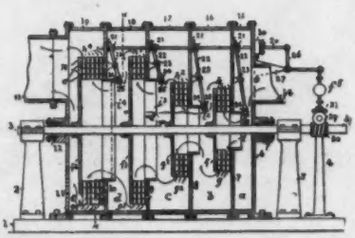
In a lightning arrester, the combination with a discharge block and conducting plates provided with lateral projections and secured to the faces of said discharge block, of insulating blocks that support the discharge block, and are provided with central recesses and with other recesses into



which the lateral projections of the conducting plates are seated, a terminal plate located in the central recess in one of the insulating blocks and provided with a boss, insulating sheets having apertures interposed between the terminal plate and one of the plates on the discharge block, and directly opposite the boss on the terminal plate, and means for clamping the parts together.

TURBINE-MOTOR. 882,127. Byron Stevens, Oakland, Cal.

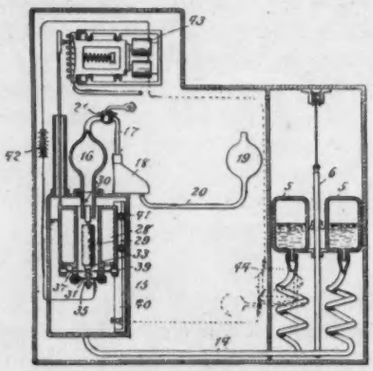
A turbine-motor composed of a series of chambers, a shaft extending through the chambers, a series of wheels in the chambers, each composed of a movable part and an immovable part, the former part being connected to the shaft while the latter part is connected to a wall of a chamber,



the vanes of the wheels being located in inter-leaved tubes alternately connected to said parts, a central fluid inlet for each wheel, a regulating valve in said inlet, and a governor or regulator adapted to operate the valves.

AUTOMATIC GAS-ANALYZER. 881,986. Henry J. Westover, New York, N. Y.

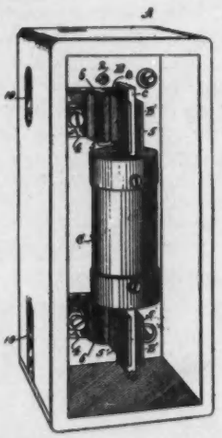
A device for controlling electric circuits in correspondence with the proportion of a given gas in a mixture, comprising two independently movable floats electrically con-



nected to each other, an insulated plate borne on one of said floats, a contact point upon the other float adapted to touch said plate, and an electric circuit, one side of which terminates in said plate and the other in said floats.

FUSE AND FUSE-BOX. 881,965. Frank L. Sessions, Columbus, Ohio, assignor, by mesne assignments, to The Jeffrey Manufacturing Company.

A fuse-carrying device comprising a pair of fuse-carrying elements, each element consisting of a pair of flat plates

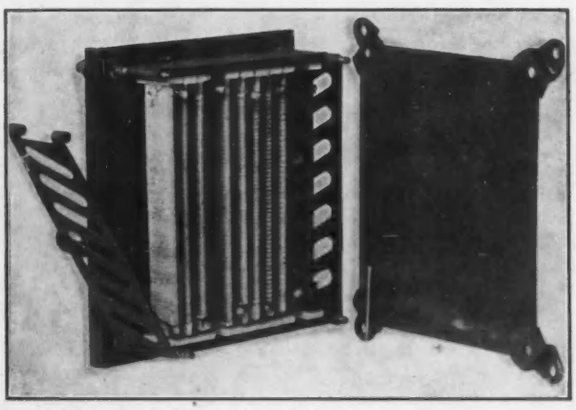


arranged parallel to each other and adapted to receive between them one terminal of a fuse, means for adjusting the plates of each carrying element relatively to each other, and means for adjusting the pairs of plates relatively to each other.

INDUSTRIAL

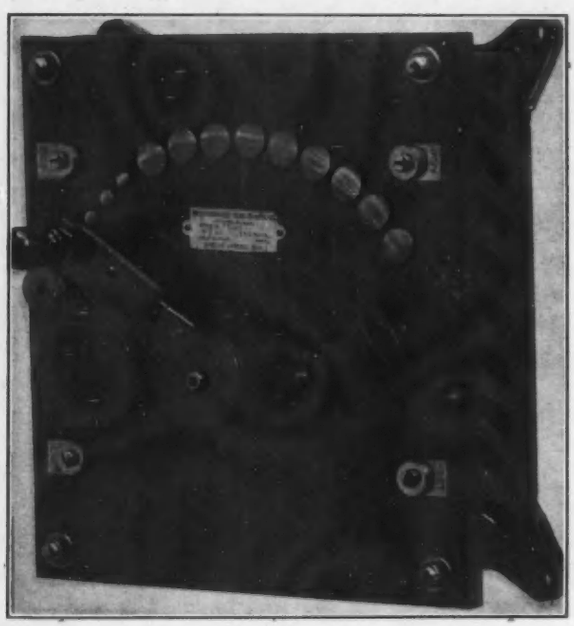
WESTINGHOUSE DIRECT-CURRENT STARTING RHEOSTATS.

Direct-current motors, except in the smallest sizes, require some sort of starting device, to keep the current within safe limits, and also to prevent the motor from starting with



BAR TYPE STARTING RESISTANCE OPEN FOR INSPECTION.

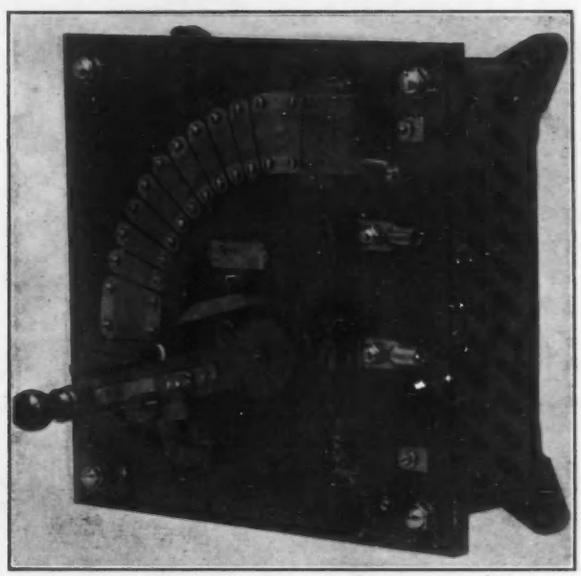
too great a rush. The necessity of using satisfactory starting devices is therefore as great as to have the motor itself reliable. The Westinghouse Electric & Mfg. Company has



FACE PLATE STARTER 50 AMPERE CAPACITY.

developed a line of face-plate starters which are thoroughly satisfactory and fully meet the specifications and conditions laid down by the National Board of Fire Underwriters and the American Institute of Electrical Engineers.

All starting rheostats are intended for use only when bringing the motor up to speed, and are not designed for regulating the speed. Speed-regulating rheostats may be obtained, but they are intended either to vary the field current of the motor, or else they must be able to regulate the much larger armature current. The rheostat which regulates the armature current must be capable of carrying the full line current continuously. Therefore this type of rheostat is considerably more expensive than the starting rheostats which are in service for only the short and infrequent periods of starting. The lower cost of the starting rheostat does not interfere with its absolutely satisfactory operation for the intermittent service of starting for which it is designed.

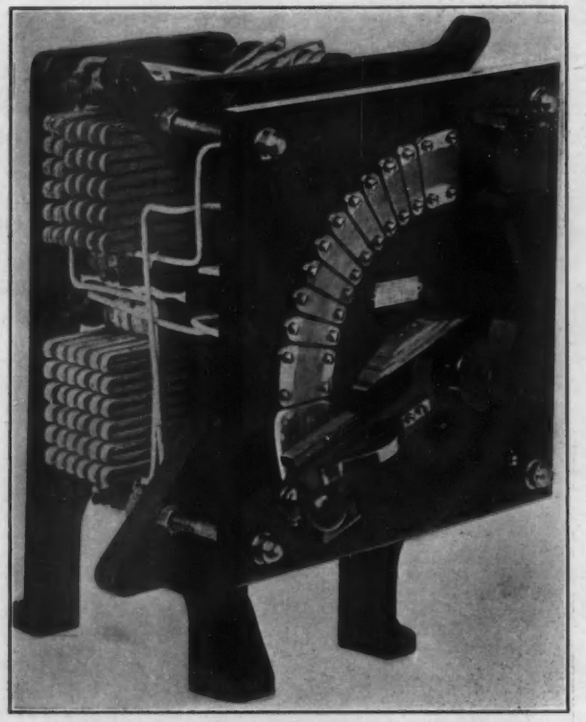


FACE PLATE STARTER 160 AMPERE CAPACITY.

The starters for motors on 110 volts up to 22 horsepower, or 220 volts up to 35 horsepower, use the bar type of resistance, which consists of a resistance wire wound on iron bars which are first covered with a fireproof material. The ends of the bars are held in place by porcelain pieces, clearly shown in the illustrations. The construction is strong and rigid, so that adjacent turns on the same bar cannot short-circuit, nor can turns on one bar come in contact with turns on another bar. The whole construction, resistance, iron frame, slate front, contact arm, etc., is fireproof.

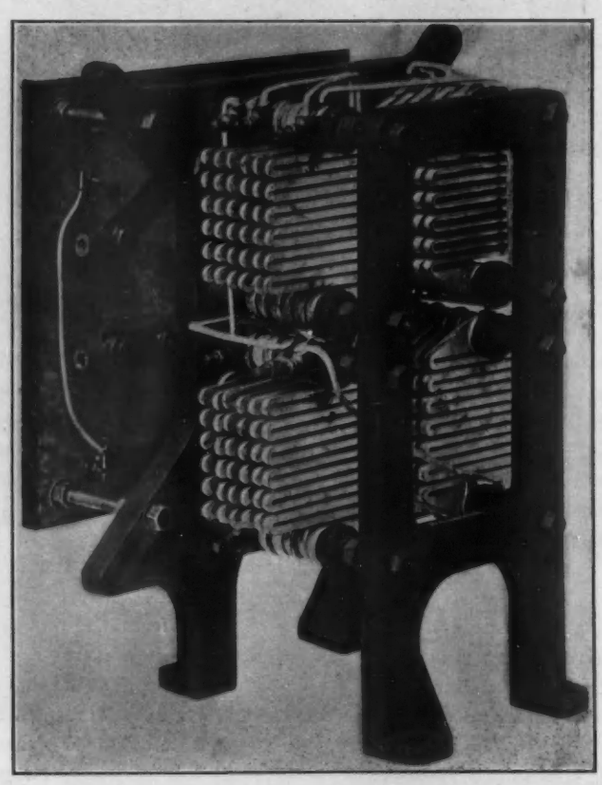
Another feature embodied in these starters is the low voltage release. The contact arm will positively fly back to the off position if the current is shut off from the line, or if the voltage falls below a fixed limit. This prevents damage to the motor should the current again be thrown on or the voltage rise suddenly to its full value. The method of connecting the magnet of the release coil will be found of special benefit where the field of the motor is to be regulated. The magnet is connected across the line independently of the shunt field and is unaffected by variations in the field current.

The small button type of rheostat shown in the illustration is used on the smaller types of motors, and is



32996—GRID TYPE STARTER 240 AMPERE FACE PLATE.

capable of carrying 80 amperes. For the larger motors larger contacts are required; this requirement is met by



32995—GRID TYPE STARTER 240 AMPERE FACE PLATE, REAR VIEW.

furnishing renewable contacts, as shown in the illustration of the 160-ampere rheostat. In this larger type of starter a special short-circuiting brush is provided which cuts out the last contact, insuring the lowest resistance possible.

For starting motors on 110 volts of 25 horsepower or 220 volts, 45 horsepower and larger, the grid type of resistance is used, which is fully ventilated and will stand the heavy duty required in starting large motors. All contacts, brushes, fingers and springs may be removed from the front with ease.

The line of rheostats is described in Leaflet No. 9,000, with full information as to dimensions, carrying capacities, etc. This line of starters is adapted for 110, 220, and 500-volt motors.

As these rheostats are used only in starting, the handle will not remain on any point except the last, unless held. They are intended to bring the motor up to speed in 15 to 30 seconds, according to size, and are made for full-load conditions.

A NEW LOCKING SOCKET.

A special lamp socket has recently been placed on the market by the General Electric Company, which should prove a boon to hotel managers, factory owners, managers of amusement resorts and others who suffer lamp losses by petty thievery.

In the old style of locking socket the lamp was held rigid in the socket, and attempts to remove it generally resulted in breaking the globe. In the new style the screw shell turns freely and the lamp cannot be removed until the shell is locked with the key.

The socket is shown in the accompanying illustration, and it should be noted that the addition of the locking feature has been made without detracting in any way from the neat appearance of the standard socket.

This locking socket should also appeal to those who had contemplated using the higher priced tantalum and tungsten lamps, but who had deferred doing so on account of the extra inducements offered to the sneak thief.

The rapid advance of the Dossert solderless connectors in the trade is shown by the steady increase in orders received for these remarkably efficient labor-saving devices. Among recent orders received by Dossert & Company, 242 West Forty-first Street, New York, are third rail clamp connectors for 1,000,000 C. M., cable from the New York Central & Hudson River R. R. Co., cable taps 400,000 C. M., main to 0000 bleeder from the Chicago City Railway Co., and cable taps for 1,000,000 C. M., cable from the Syracuse & South Bay Electric Ry. Co.

NEWS NOTES

TRANSPORTATION.

Reno.—The Virginia and Truckee Electric Railway Company is planning on changing its line to an electric system. Chief Engineer Kirk of the road was in Reno the first of last week conferring with City Electrician Caffrey.

Riverside.—Wiring has been begun on the trolley line to Crestmore, where a large cement plant is situated. The road is about 6 miles long, and will be operated by the Arlington R. R. Co., which is owned by H. E. Huntington.

Reno.—Within 60 days the cars of the Reno Traction Company and the Interurban Railway Company will be running over Center and Second Streets from the new terminal to be provided at the intersection of Center Street and Commercial Row.

San Francisco.—The Board of Supervisors has adopted a resolution allowing the United Railroads Company to use the Sutter Street tracks on the lower end of Market Street for trolley purposes for 15 days more, pending some permanent settlement of the questions involved.

Stockton.—The first decided step taken to construct a road through the Manteca French Camp and Ripon district to the south and east of Stockton last week, when articles of incorporation of the San Joaquin Investment Company were filed. One of the principal objects of the corporation is to secure rights of way for the electric road, which will be built by the Central California Traction Company.

Oakland.—The late car service on the Oakland and Berkeley lines of the Oakland Traction Company is to be restored. E. A. Heron, president and general manager of the Oakland Traction Company, has assured the Merchants' Exchange of Oakland that in the near future cars will be running on the company's lines that will connect with the last Key Route ferryboat, and also accommodate late visitors from Oakland.

Visalia.—The Visalia electric line will begin operations in a few days between Visalia and Lemon Cove, in Exeter. The Visalia Electric Railway owns its own tracks in the city of Visalia, and also between Exeter and Lemon Cove, and has obtained trackage rights between Exeter and Visalia from the Southern Pacific. It is estimated that next season 250 carloads of citrus fruit will be moved from this section.

San Jacinto.—Talk of the proposed electric road from Redlands to San Jacinto and Hemet is being revived, and the matter will be made the subject of discussion at the next meeting of the Board of Trade. A preliminary survey for the trolley road was made about a year ago, at a cost of several hundred dollars, but since then nothing further has been done. W. F. Whittier is willing to build it, according to report.

Oakland.—Within a few weeks the mile of narrow gauge track that at present connects with the Oakland-Hayward car line a mile out of Hayward, will have been transformed into broad gauge, and the cars of the Oakland Traction Company will run direct into Hayward. This improvement will cut several minutes or more from the running schedule, as much time is lost in transferring at the point a mile distant from the center of town. Recently the engineers of the Oakland Traction completed the survey of the line of track, and last week workmen began laying a stretch of broad-gauge rails. The Hayward cross lines will also be broad gauged, and the larger cars of the Oakland Traction Company put in service in the suburban town.

WATERWORKS.

Biggs.—W. M. Doty, of this city, has been awarded a contract to erect and install a sprinkling plant by the Board of Supervisors. This contract will require two large iron tanks, and some 4,000 feet of piping, which will be connected with the city water system.

Ogden, Utah.—As preliminary to the erection of a municipal power plant and the installation of a municipal water system, A. E. Parker, city engineer, acting under the direction of Mayor Brewer and the City Council, filed two applications with the State engineer for water in South Fork Canyon, a tributary stream to the Ogden River.

San Francisco.—Unless some settlement of the Reis tract water war is effected immediately the water to all consumers will be shut off, according to an official announcement made by the County Line Water Company. T. B. Potter, the principal owner of the County Line Water Company, was unable to attend the recent meeting held by the citizens, but addressed a letter, in which he said: "Should the people of the Reis tract decide not to accept the offer made by me, and can induce either the city or the Spring Valley Water Company to furnish the entire district with water, I will make a free gift for this purpose of all the pipe lines in the streets in this district now belonging to the County Line Water Company, provided immediate action is taken." Mr. Potter's offer was, in substance, to sell water at $2.10 per month per lot, providing 300 consumers signed an agreement to take one share of the stock free in the County Line Water Company, thus making it nominally a mutual concern, but while 117 have so agreed, 183 refuse to sign. Mr. Potter claims that it costs $510 per month to operate the plant, and that the consumers must meet this cost or the water plant will be closed down.

OIL.

Santa Maria.—The Union Oil Company is now awaiting confirmation of the sale of the Teresa Bell tract, and will immediately erect a derrick and begin operations on this land. This property was recently bid in by this company for $440,000. Its northern line runs parallel with the Blochman property, the Palmer well being not more than 100 feet from the line.

San Francisco.—Henry J. Crocker, of the California Petroleum Refineries, entered a denial last week to the report that the big plant at Oilport was to be sold. The report followed the arrival of John Hay, of London, who represents the English capitalists interested in the plant. Mr. Hay is now at Oilport, but, according to Mr. Crocker, his visit there is merely for the purpose of inspection.

Pasadena.—The annual meeting of the Revenue Oil Company was held March 18th. Secretary R. H. Pinney reported that the year's receipts amounted to $41,000, this being under the old contract of 27 cents per barrel. Under the new contract the coming year's output has been sold to the Associated Oil Companies for over 60 cents per barrel, and it is expected that the output will be 9,000 barrels each month. At the last meeting 135,000 of the 200,000 shares were represented. The directors elected included J. F. Ker, Thomas Earley, C. B. Scoville, C. H. Hamilton, and Isaac Vailey.

INCORPORATIONS.

Orange, Cal.—The Juego Land & Water Company has been incorporated with a capital stock of $10,000. The place of business is Los Patos.

Seattle, Wash.—The N. & S. Electric Company has been incorporated with a capital stock of $24,000 by Robert Wilhelm and Wilson Niedergesaess.

Los Angeles.—The United States Electrical Manufacturing Company has been incorporated by Timothy Mahoney, J. R. Amestoy, W. J. Sheriff, G. Russo and Edgar Sharp. The capital stock is $200,000.

Santa Rosa, Cal.—The Chileno Valley Telephone Company has been incorporated with a capital stock of $5,000, by C. G. Martin, M. De Martini, H. Juhl and A. J. Bloom of Marin County, and J. L. Schwobeda of Sonoma County.

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